Edward C. Edelman

July 10, 2000

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

HONEYWELL, INC. and HONEYWELL)
INTERNATIONAL, INC.,   )
)
        Plaintiffs,   )
)
vs.   ) Case No. 99-309 (GMS)
)
HAMILTON SUNDSTRAND   )
CORPORATION,   )
)
        Defendant.   )
_____   )

VIDEOTAPED DEPOSITION OF EDWARD C. EDELMAN
Los Angeles, California
Monday, July 10, 2000

Reported by:
DAYNA HESTER
CSR No. 9970
JOB No. 829934

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6   )
    HAMILTON SUNDSTRAND   )
7   CORPORATION,   )
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8   Defendant.   )
    _____)
9
10
11
12   Videotaped deposition of EDWARD C.
13 EDELMAN, taken on behalf of Defendants
14 at 777 South Figueroa Street, 34th
15 Floor, Los Angeles, California,
16 beginning at 9:13 a.m. and ending at
17 4:47 p.m., Monday, July 10, 2000, before
18 DAYNA HESTER, Certified Shorthand
19 Reporter No. 9970.
20
21
22
23
24
25

2

1
2   INDEX
3   WITNESS   EXAMINATION
4   EDWARD C. EDELMAN
5   MR. BRAFMAN   8
6
7   EXHIBITS
    DEPOSITION   MARKED
8
    59   Memo dated September 1, 1992 to   46
9   Distribution from Ed Edelman on
          the letterhead of Sundstrand
10   Aerospace, with attachments;
          6 pages
11
    60   Document entitled "Coordination   49
12   memo," dated February 21, 1992;
          2 pages
13
    61   Document entitled "Coordination   59
14   memo," dated 1/5/93; 2 pages
15 62   Document entitled "Coordination   69
          memo," dated 1 Jul 93; 10 pages
16
    63   Document entitled "Problem &   80
17   Corrective Action Report (PCR)";
          3 pages
18
    64   Document entitled "Coordination   86
19   memo," dated 24/10/94; 2 pages
20 65   Document entitled "Coordination   89
          memo," dated 4 Nov 94; 1 page
21
    66   Document entitled "Coordination   94
22   memo," dated 7 Nov 94; 4 pages
23 67   Document entitled "Software Problem   96
          Report"; 35 pages
24
    68   Document entitled "Coordination   105
25   memo," dated 30/11/92; 2 pages

4

Edward C. Edelman   July 10, 2000

1   Los Angeles, California, Monday, July 10, 2000
2   9:13 a.m. to 4:47 p.m.
3
4   VIDEOGRAPHER: Good morning. This begins
5   videotape No. 1 in the deposition of Ed Edelman in the
6   matter of Honeywell, Incorporated, versus Hamilton
7   Sundstrand, Corporation in the United States District
8   Court for the District of Delaware. The case number of
9   which is 99-309 (GMS).
10   Today's date is July 10, 2000. The time is
11   9:14 a.m. This deposition is being taken at 777 South
12   Figueroa Street, Suite 3400 in Los Angeles, California
13   and was made at the request of David Brafman of the law
14   offices of Kirkland & Ellis.
15   The videographer is Lisa Livote, employed by
16   Esquire Deposition Services, located at 6222 Wilshire
17   Boulevard, Suite 204 in Los Angeles, California.
18   Would counsel please identify yourselves and
19   state whom you represent.
20   MR. BRAFMAN: I'm David Brafman for Kirkland &
21   Ellis representing Plaintiffs Honeywell.
22   MR. McCRACKEN: William McCracken for Marshall
23   O'Toole in Chicago representing Defendant Hamilton
24   Sundstrand Corporation.
25   VIDEOGRAPHER: Would the court reporter please

                              7

1   swear in the witness.
2
3   EDWARD C. EDELMAN,
4
5   BY MR. BRAFMAN:
6   Q   Please state your name.
7   A   Edward C. Edelman.
8   Q   Where do you live?
9   A   I live in Agoura Hills, California.
10   Q   You used to work for Sundstrand, correct?
11   A   Right. Uh-huh.
12   Q   And before that, you had worked for
13   AlliedSignal?
14   A   Yes.
15   Q   But today you are being represented by a lawyer
16   for the Defendants Hamilton Sundstrand, correct?
17   A   Yes.
18   Q   And today you are closer with Sundstrand; you
19   are connected with Sundstrand but not AlliedSignal,
20   correct?
21   A   Closer? I don't understand.
22   Q   Sure. I'll rephrase.
23   You are not being represented by a Honeywell
24   lawyer, correct?
25   A   That's true.

                              8

Edward C. Edelman   July 10, 2000

1   Q   And you are not -- you haven't discussed this
2   case with anyone at Honeywell, correct?
3   A   That's correct.
4   Q   But you are -- still maintain ties to
5   Sundstrand, correct?
6   A   Just with this case, uh-huh.
7   Q   Did you prepare in any way for today's
8   deposition?
9   A   Yes.
10   Q   How did you prepare?
11   A   We -- I prepared with Tom Miller over the phone
12   and --
13   Q   Who is Tom Miller?
14   A   Tom Miller is a lawyer representing Sundstrand
15   and --
16   Q   When did you speak with Mr. Miller?
17   A   Friday.
18   Q   For about how long?
19   A   Thirty minutes.
20   Q   Was there anyone else on the telephone?
21   A   No. Uh-huh.
22   Q   Okay. Did you have any other conversations or
23   meetings to prepare for today?
24   A   Yes. There was one before that.
25   Q   With whom did you speak with before?

                            9

1   A   Actually, I don't remember the name of the
2   lawyers. It was about a year ago. And it was for about
3   two hours.
4   Q   Was that a lawyer for Sundstrand?
5   A   Yes. Uh-huh.
6   Q   Do you know if it was a lawyer that worked for
7   Sundstrand or was it an outside lawyer for Sundstrand?
8   A   I don't recall.
9   Q   Was there anyone else with you in that
10   conversation besides the other lawyer?
11   A   Yeah. There was someone on the phone.
12   Q   Do you recall who it was?
13   A   No, I don't.
14   Q   Do you recall who he worked for?
15   A   I assume Sundstrand but I don't know the
16   answer.
17   Q   Did you review any documents in preparation for
18   today?
19   A   No. They provided me with two documents but I
20   never -- I didn't review them.
21   Q   "They," being Sundstrand's lawyers?
22   A   Right. Uh-huh.
23   Q   Did you bring those documents with you today?
24   A   No.
25   Q   Did you review anyone's deposition testimony

                            10

1   from this case?
2   A   No.
3   Q   Did you speak to anyone about their testimony
4   from this case?
5   A   No.
6   Q   I'd like to very briefly go over your
7   education.
8   Do you have a college degree?
9   A   Yes, I do.
10   Q   From where?
11   A   University of Washington.
12   Q   What's your degree in?
13   A   Mechanical engineering.
14   Q   When did you get your mechanical engineering
15   degree?
16   A   1984.
17   Q   Did you have any further formal education after
18   that degree?
19   A   I -- yeah, I went to postgraduate school but
20   never graduated.
21   Q   Which graduate school did you go to?
22   A   University of Arizona and Arizona State
23   University.
24   Q   Did you go to University of Arizona right after
25   graduating from University of Washington?

                            11

1   A   Yes. Uh-huh.
2   Q   Did you focus on a certain area of study at
3   University of Arizona?
4   A   Yes. Controls.
5   Q   What type of controls?
6   A   Just general control classes.
7   Q   Control theory?
8   A   Yeah, Control theory.
9   Q   For how long were you at University of Arizona?
10   A   Two years.
11   Q   From there, you went to another University?
12   A   Arizona State University.
13   Q   For how long were you at Arizona State?
14   A   I -- my best estimate is about two more years.
15   Q   What was your focus of study at Arizona State?
16   A   Controls.
17   Q   So you had four years of graduate education in
18   controls?
19   A   Yeah. Uh-huh.
20   Q   That brings us to about 1988?
21   A   Yes.
22   Q   Okay. Where did you go after leaving Arizona
23   State?
24   A   Well, I was working at AlliedSignal at the same
25   time.

                            12

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Edward C. Edelman   July 10, 2000

1   Q   Okay. When did you start working at
2 AlliedSignal?
3   A   1986.
4   Q   Back then, was it called Garrett?
5   A   Yes. Garrett engine division.
6   Q   What was your initial position at Garrett or
7 AlliedSignal?
8   A   I was a controls engineer.
9   Q   In what area were you working? Where were you
10 controlling?
11   A   The engine division. So I worked on the
12 TFE731.
13   Q   Is that an auxiliary power unit?
14   A   No, it is not.
15   Q   What is that?
16   A   It's a main engine for small aircraft.
17   Q   And what do you mean by "small aircraft"?
18   A   Like a Lear Jet, for example, business jets.
19   Q   Okay. What other engines did you work on while
20 at Garrett?
21   A   The TFE1042.
22   Q   That is a main engine as well?
23   A   Yes.
24   Q   Did you work on any other engines at Garrett?
25   A   No.

                          13

1   Q   Did you work on any APUs while at Garrett?
2   A   No.
3   Q   Did your responsibilities while at Garrett
4 include anything other than controls for the two main
5 engines you mentioned?
6   A   Other responsibilities?
7   Q   Yes.
8   A   Yes.
9   Q   What else did you do while working at Garrett?
10   A   I did simulation for different engines. So I
11 did some simulation work for the TPE331 which is a
12 turboprop main engines.
13   Q   Any others?
14   A   Not that I can recall.
15   Q   Other than -- other than the controls for the
16 two main engines and the simulation on the turboprop
17 engine, did you work on any other engines or APUs?
18   A   No.
19   Q   Did you have any other responsibilities?
20   A   Not that I can recall.
21   Q   While at AlliedSignal, did you have any
22 connection with APUs at all?
23   A   No.
24   Q   Did you ever see documents concerning APUs?
25   A   No.

                          14

1   Q   Talk with anyone who worked in that unit about
2 their work?
3   A   No.
4   Q   When did you leave AlliedSignal?
5   A   Nineteen ninety -- no. Yeah, 1991.
6   Q   Why did you leave AlliedSignal?
7   A   I wanted to try something different.
8   Q   What didn't you like about what you had been
9 doing at Allied?
10   A   I liked the job.
11   Q   What was it about it that made you want to
12 switch?
13   A   I just wanted to try something different.
14   Q   Where did you go from AlliedSignal?
15   A   To Sundstrand.
16   Q   What was your first position at Sundstrand?
17   A   I was an engineer.
18   Q   Were you assigned to a certain project?
19   A   Yes. The APS3200.
20   Q   At the time you joined Sundstrand, was it
21 called the APS3200?
22   A   To the best of my recollection.
23   Q   What was your specific responsibility when you
24 got to Sundstrand concerning the APS3200?
25   A   It was to develop controls. So I was a systems

                          15

1 engineer.
2   Q   What were your -- what were you controlling in
3 the APS3200?
4   A   Engine operation.
5   Q   Were there specific parts of the operation of
6 the engine that you were responsible for?
7   A   Just overall system operation.
8   Q   The whole -- the whole control?
9   A   Yeah. Yeah.
10   Q   Had anyone begun working on control for the
11 APS3200 before you got there?
12   A   Yes.
13   Q   Who was that?
14   A   Korosh Mehr-Ayin and Allen Grubal.
15   Q   For the benefit of the court reporter, could
16 you spell out the first name you gave?
17   A   Korosh, K-O-R-O-S-H, M-E-H-R A-Y-I-N.
18   Q   Did you take over responsibility from one of
19 those engineers or did you work with them?
20   A   I worked with them.
21   Q   Who had primary responsibility for the APS3200
22 control when you arrived?
23   A   Korosh.
24   Q   And did that continue while you were working
25 there?

                          16

Edward C. Edelman   July 10, 2000

1   A   Yeah. He was my boss. Uh-huh.
?   Q   Could you pronounce his last name again?
)   A   Mehr-Ayin.
4   Q   Did Mr. Mehr-Ayin work day to day on the
5   control or was he more supervisory while you did the
6   day-to-day work?
7   A   Yeah. He was more supervisory.
8   Q   When you arrived at Sundstrand, was there a
9   working model of the APS3200 yet?
10   A   I – yes. Uh-huh.
11   Q   And there were control – there was control
12   software written?
13   A   Yes.
14   Q   Did your responsibilities at Sundstrand ever
15   change from your first position?
16   A   No.
17   Q   The whole time you were there, you worked on
18   control for the APS3200?
19   A   Yes.
20   Q   Did you ever work on any other model APUs while
21   at Sundstrand?
22   A   Yeah. There were – there were some small side
23   jobs that I would work on.
24   Q   Those were minor tasks?
25   A   Minor tasks, yes.

17

1   between the 3000 and the 3200.
2   Q   Okay. In your mind, they are the same APU?
3   A   I – to be – I didn't – I don't know the
4   existence of the 3000. I don't – I don't know what it
5   is.
6   Q   Okay.
7   A   I don't know if they are the same APU or not.
8   Q   Okay. To your knowledge, there was no separate
9   APU called the APS3000? Is that a fair summary of what
10   you are saying?
11   A   I don't know anything about it. I really can't
12   answer that.
13   Q   Why –
14   A   I don't know what an APS3000 is. So, I mean,
15   from the time I came, it was referred to as the APS3200.
16   Q   While you were at Sundstrand, had you ever
17   heard of the model APS3000?
18   A   Uh-uh.
19   Q   Okay. So you never heard the term before?
20   A   That's right.
21   Q   When did you first hear of the APS3000, just
22   from my question?
23   A   When you asked the question, yeah.
24   Q   Okay. Did you support the marketing efforts
25   for the APS3200 at all?

19

1   Q   Okay. When did you leave Sundstrand?
2   A   1995.
3   Q   Why did you leave Sundstrand?
4   A   I wanted to change. I wanted to work for a
5   small company.
6   Q   Were you unhappy with anything about working at
7   Sundstrand?
8   A   No.
9   Q   Did you leave on good terms with the company?
10   A   Yes.
11   Q   Are you still – other than when this lawsuit
12   came up last year, had you been in contact at all with
13   Sundstrand or the people who worked there?
14   A   Through – maybe three or four years ago, but
15   not recently.
16   Q   You lost touch?
17   A   Yes. Uh-huh.
18   Q   Did you ever work on the APS3000?
19   A   No.
20   Q   Was there someone else at Sundstrand with
21   responsibility for control of the APS3000?
22   A   That was before I came so I can't answer that.
23   Q   By the time you came, work on the APS3000 had
24   stopped?
?5   A   To be honest, I don't know the difference

18

1   A   No.
2   Q   Your work was strictly in engineering?
3   A   Yes.
4   Q   After you left Sundstrand in 1995, where did
5   you go?
6   A   Capstone Turbine Corporation.
7   Q   What kind of company is Capstone?
8   A   We make a small micro turbine 30 kilowatt to 60
9   kilowatt range.
10   Q   What is that turbine used for?
11   A   Ground power.
12   Q   That is power for an aircraft?
13   A   No.
14   Q   What do you mean by "ground power"?
15   A   For back up power, emergency power.
16   Q   Like for a building, like a hospital?
17   A   Uh-huh.
18   Q   You have to answer "yes" –
19   A   Yes. Yes.
20   Q   – for the court reporter.
21   A   Okay.
22   Q   Are you still at Capstone?
23   A   Yes.
24   Q   What's your position at Capstone?
25   A   I am a controls engineer.

20

Edward C. Edelman   July 10, 2000

1   Q   Who did you work with at Sundstrand on
2 controlling the APS3200?
3   A   I worked with Korosh and Alan Greubel.
4   Q   Anybody else?
5   A   In terms of the controls group, Tim Sullivan.
6   Q   What was Tim's role?
7   A   He was a fuel controls engineer.
8   Q   Did your control responsibility extend to fuel
9 control?
10   A   No. Just — no, it didn't.
11   Q   Can you think of any Sundstrand engineers that
12 you worked with on the APS3200?
13   A   In — in the controls group or in the — in the
14 entire project?
15   Q   Tell me how the engineers were broken out with
16 respect to APS3200.
17   A   Well, there was a project office and there was
18 a controls system group and in the project office Pete
19 Suttie was my main interface.
20   Q   What was the responsibility of the project
21 office?
22   A   Interface with customer, schedules, make sure
23 the project was done on time.
24   Q   Was the project office more administrative?
25   A   Yes. Uh-huh.

                              21

1   Q   Who was the customer for the APS3200?
2   A   Deutsche Sharbus (phonetic).
3   Q   Deutsche as in D-E-U-T-S-C-H-E?
4   A   S-C-H-E.
5   Q   Who worked on the engineering of the APU as
6 opposed to the control for the APU?
7   A   The engineering of the APU.
8   Q   Was Sundstrand responsible for billing the APU
9 as well as the control for the APS3200?
10   A   Yeah. It was — it was also manufactured for
11 Sundstrand.
12   Q   Were you involved in the physical APU as well
13 or just the control of it?
14   A   Just the controls.
15   Q   Did you work at all with anyone from Turbomeca?
16   A   Yes. Uh-huh.
17   Q   What was Turbomeca's role with respect to
18 control of the APS3200?
19   A   They designed the — the engine hardware.
20   So I — everything that wasn't electronic, you
21 can think of it that way.
22   Q   Did you have a main contact with Turbomeca?
23   A   No. I worked with several Turbomeca engineers.
24   Q   Who were the Turbomeca engineers that you
25 worked with?

                              22

1   A   The only one that I can remember is Bernie
2 Macarez.
3   Q   Do you know how to spell his last name?
4   A   No.
5   Q   Macarez?
6   A   Macarez. I can't recall the rest of them.
7 It's been — it's been too long.
8   Q   Were the Turbomeca engineers that you worked
9 with based in the United States or were they from
10 France?
11   A   Bernie was in the United States; the rest were
12 in France.
13   Q   Did you ever work with someone named
14 Al Ducrocq, D-U-C-R-O-C-Q?
15   A   I don't recall.
16   Q   Was Mr. Mehr-Ayin your boss the whole time you
17 were at Sundstrand?
18   A   No. He left after three years.
19   Q   Who filled his role after he left?
20   A   Steve Lampe.
21   Q   Was there anyone after Mr. Lampe?
22   A   Yes. He left to go to work for Capstone and
23 then it was Jane Lanham.
24   Q   And was Ms. Lanham the last person you worked
25 for?

                              23

1   A   Yes.
2   Q   Part of your responsibilities included
3 controlling the bleed valve in the APS3200; is that
4 correct?
5   A   Yes.
6   Q   Is that what you called it, the bleed valve?
7 Do I have the terminology right?
8   A   We called it the bleed control valve.
9   Q   Bleed control valve.
10   What's the primary purpose in controlling the
11 bleed control valve?
12   A   To provide air for main engine starts and air
13 for the air condition — the conditioning unit on the
14 aircraft. Environmental control system.
15   Q   Is the purpose of controlling that valve to
16 provide the air required for those functions while
17 avoiding something called surge?
18   A   Yes. Uh-huh.
19   Q   What is surge?
20   A   Surge is a backflow across the compressor.
21   Q   By "backflow," do you mean the air moves
22 backwards?
23   A   Yes. Uh-huh.
24   Q   Why is it that you tried to avoid surge?
25   A   It can damage the engine.

                              24

Edward C. Edelman   July 10, 2000

1   Q   Is surge very damaging to an APU?
2   A   Yes. It can render it nonfunctional.
     Q   Roughly how long does it take for an APU to get
4   damaged while in surge? Is it matter of a seconds?
5   Minutes? Hours?
6   A   I don't know.
7   Q   For the time while you were at Sundstrand, were
8   you the most knowledgeable person regarding the way the
9   surge control operated?
10   A   Yes, I would say so.
11   Q   Who else do you believe had a good knowledge of
12   the way surge control operated while you were there at
13   the APS3200?
14   A   All of the controls engineers.
15   Q   Mr. Greubel and Mr. Mehr-Ayin?
16   A   Uh-huh. Yes.
17   Q   Were there any other surge -- rather, control
18   engineers while you were there?
19   A   Terry Meche. He was there briefly. That's all
20   I can recall.
21   Q   Do you know how to spell his last name?
22   A   No. It's M-E-C-H-E or maybe it's M-E-A-C-H-E.
23   I can't recall.
24   Q   When you first got to Sundstrand, what was the
25   basic algorithm for controlling the bleed control valve,

                                    25

1   do you recall?
2   A   Yes. For controlling the bleed -- yeah, we
3   used a measured delta P over P. It was a sensor that
4   would sense airflow.
5   Q   So you used a sensor to determine delta P over
6   P?
7   A   Yeah. Well, those were the sensors. I mean,
8   the sensor was a delta P over P sensor.
9   Q   So it was a sensor that measured -- measured
10   airflow and gave a value that represents delta P over P,
11   is that...
12   A   It would actually measure pressure.
13   Q   Okay. And once the APU control had this delta
14   P over P what did it do with it?
15   A   It was used to regulate the bleed valve.
16   Q   How did delta P over P get used to control the
17   bleed valve at first?
18   A   At first?
19   Q   In other words, the control algorithm as it
20   stood when you got to Sundstrand?
21   A   I don't recall the exact control algorithm. I
22   know that the sensors were in place and there was a
23   proportional plus integral control and so my job was to
24   kind of to refine that control.
25   Q   Did the first control for the APS3200 that you

                                    26

1   knew of take the position of the inlet guide vanes into
2   account in controlling the bleed control valve?
3   A   I don't recall.
4   Q   Do you recall any bleed control valve control
5   scheme for the APS3200 that took the position of the
6   inlet guide vanes into account?
7   A   I don't remember.
8   Q   You don't remember any of them?
9   A   I don't remember if the IGV was involved in the
10   control log.
11   Q   Am I correct that the APS3200 has a gas turbine
12   engine?
13   A   Yes. Uh-huh.
14   Q   The APS3200 has a load compressor?
15   A   Yes. Uh-huh.
16   Q   Load compressor of the APS3200 has adjustable
17   inlet guide vanes?
18   A   Yes.
19   Q   Does the load compressor receive, compress and
20   discharge air?
21   A   It's been so long, I don't recall.
22   Q   Do you recall whether air is discharged from
23   load compressor and is connected to the aircraft?
24   A   Yes. Uh-huh.
25   Q   Am I correct that the air from the load

                                    27

1   compressor connects to pneumatically powered parts of
2   the aircraft?
3   MR. McCRACKEN: Objection. Vague.
4   THE WITNESS: I don't understand the question,
5   "pneumatic."
6   BY MR. BRAFMAN:
7   Q   Do you understand the term "pneumatic"?
8   A   Yeah. It's -- it's airflow actuated equipment.
9   Q   I think you mentioned earlier the APU was
10   connected to starting the main engines and providing air
11   condition on the aircraft?
12   A   Yes. Right.
13   Q   Are those functions providing air conditioning
14   or starting the main engines a pneumatic action?
15   A   Yeah. I mean, it's -- it's airflow. Yeah.
16   Q   Am I correct that the APS3200 had the bleed
17   control valve positioned between the outlet from the
18   compressor and the aircraft to control how much air went
19   to the aircraft?
20   A   Yes.
21   Q   And that if it didn't go to the aircraft from
22   the APS3200, instead it went to exhaust, it got
23   discharged into the air?
24   A   Yes.
25   Q   Was the bleed control valve able to variably

                                    28

Edward C. Edelman
July 10, 2000

1   regulate how much air went to the aircraft versus
2   exhaust?
3   A   Yes.
4   Q   You referred earlier to this delta P over P
5   sensor.
6   A   Yes.
7   Q   Do you know whether there was one sensor or
8   more than one involved?
9   A   I believe it was one sensor body. It was
10 encompassed in one package, if that's what you mean.
11   Q   Is it your understanding that delta P over P is
12 a flow-related parameter?
13   A   Yes.
14   Q   Am I correct that as part of the control for
15 the bleed control valve the measured or actual delta P
16 over P was compared to a desired value?
17   A   Yes.
18   Q   That desired value is sometimes called a
19 setpoint?
20   A   Yes.
21   Q   In your work on the control for the APS3200,
22 did you focus on software? On the electronics? Or
23 both?
24   A   My focus was mainly on the software.
25   Q   Did you work at all on the electronics?

29

1   A   No.
2   Q   Who was responsible for the electronics of the
3   control for the APS3200?
4   A   Bill Conn was primarily responsible.
5   Q   K-A-H-N, Kahn?
6   A   No. It was C-O-N-N.
7   Q   Was Mr. Conn still at Sundstrand when you left?
8   A   Yes.
9   Q   Do you know if he is still there today?
10   A   I don't know.
11   Q   Are you familiar with the electronics in the
12 control for the APS3200?
13   A   Generally familiar.
14   Q   In the APS3200, was the setpoint for delta P
15 over P adjustable?
16   A   I believe there were two setpoints. There was
17 a setpoint of 0.2 and then there was a lower setpoint
18 that would -- had a higher gain associated with it. And
19 it was at .17.
20   Q   Why were there two setpoints for delta P
21 over P?
22   A   We would increase the gain if we -- if we got
23 too close to a search condition to allow it to recover
24 faster.
25   Q   Please explain how increasing the gain would

30

1   allow the APU to recover and move away from surge?
2   A   It would magnify the air term and cause the
3   bleed control valve to move faster. So it -- it -- the
4   signal passes through a proportional plus integral
5   control, the air signal does. And then that generates
6   the valve position; by increasing the gain, it magnifies
7   the air rate at which the valve moves.
8   Q   So after the delta P over P is compared to the
9   setpoint, that -- that generates an error signal?
10   A   Yes.
11   Q   And the error signal passes to a proportional
12 controller and an integral controller?
13   A   Yes.
14   Q   And the signals on those controllers operate
15 the bleed control valve?
16   A   Yes.
17   Q   And make it move?
18   A   Yes.
19   Q   And by changing the setpoint you made the bleed
20 control valve move faster; do I understand that right?
21   A   Well, if the -- if you -- 0.2 gave us enough
22 surge margin so it wouldn't surge the engine. If you
23 got closer to surge at the setpoint of .17 it would
24 cause it to move faster to get it to react quicker.
25   Q   I want to clarify one thing. When you say

31

1   "faster," do you mean the bleed control valve would
2   begin to move earlier or did the speed at which it moved
3   actually speed up?
4   A   Yes. The speed.
5   Q   Sped up?
6   A   Uh-huh.
7   Q   And when you speak of moving the bleed control
8   valve to avoid surge, do you mean direct more air
9   towards the exhaust?
10   A   Yes.
11   Q   Is it the function of the proportional
12 controller in the APS3200 to produce a signal
13 proportionally related to the error signal?
14   A   Yes.
15   Q   And the integral controller produces a signal
16 that's integrally related to the error signal?
17   A   Yes.
18   Q   And those signals are combined in controlling
19 the valve?
20   A   Yes.
21   Q   What determined which of the two delta P over P
22 setpoints that you mentioned would be in use at any
23 given time?
24   MR. McCRACKEN: Objection. Ambiguous.
25   THE WITNESS: I'm not sure I understand the

32

Edward C. Edelman   July 10, 2000

1   question.
2   BY MR. BRAFMAN:
3   Q   When I asked you whether the setpoint for delta
4   P over P was adjustable, you mentioned that there were
5   two possible settings for the setpoints; am I correct?
6   A   You'll have to define adjustable. I'm not
7   sure. There were two setpoints but I would not refer to
8   them as adjustable. I would -- there's one setpoint and
9   then there was a second setpoint.
10   Q   Okay. Am I correct that there were not two
11 setpoints in use simultaneously but that the setpoint
12 could be one of two options; am I correct or am I wrong?
13   A   No. They were operating at the same time. So
14 one was for steady stay control. The second was due to
15 a dynamic response.
16   Q   Am I correct, though, that only one setpoint
17 was in use at any one time?
18   In other words, the setpoint is used in that
19 it's compared to the actual delta P over P; am I right?
20   A   Yes. That's true.
21   Q   Okay. So the control has to select a value to
22 use for setpoints in comparing setpoint with delta P
23 over P, correct?
24   A   They are both active at the same time. So it
25 doesn't -- I don't quite understand the question.

                            33

1   Q   Sure.
2   Did the -- was the component that did this
3   comparison between the setpoint and delta P over P, was
4   it a comparator?
5   A   It would -- we would generate an air term. So
6   in logic, it would look at the setpoint versus the speed
7   back and the speed feedback in -- or the delta P over P
8   feedback.
9   Q   It was done in general software?
10   A   Yes. Yes, it was done in software.
11   Q   And was the setpoint represented by a variable
12 in the software?
13   A   I don't recall. It was fixed as far as I
14 remember. 0.2.
15   Q   How many error signals were generated as a
16 result of comparing setpoint to delta P over P in the
17 software?
18   A   There was one error signal.
19   Q   Okay. So what I guess I am trying to
20 understand is, to generate the error signal, don't you
21 have to compare delta P over P with a certain value?
22   A   Yes.
23   Q   And it has to be one value?
24   A   Yes.
25   Q   Okay.

                            34

1   A   It doesn't have to be one value. But it -- in
2   this case, it was.
3   Q   Okay. If there were two options for setpoint
4   or two settings or two values for setpoints, how did the
5   software know what the single error signal is?
6   A   I'm not sure. I'd have to look at a diagram
7   to -- to bring back the memory of how that exactly
8   worked.
9   Q   Okay. What -- what documents are you aware of
10 that would document the way the control for the 3200
11 worked?
12   A   We had a system specification.
13   Q   Mr. Edelman, I'm going to hand you what has
14 been previously marked as Exhibit 46 bearing production
15 Nos. HSA 176217 to 176295.
16   Mr. Edelman, have you ever seen Exhibit 46
17 before?
18   A   We have several documents here.
19   Q   I believe they are all part of one document.
20 If you see, they are numbered in the upper right-hand
21 corner in a way that suggests they are part of one
22 large --
23   A   This right here?
24   Q   If you look at the time, it's 1079 and then -15
25 and keeps going.

                            35

1   A   Okay.
2   Q   Take whatever time you need to flip through it
3   and let me know whether you recall ever seeing it
4   before.
5   A   It looks like a presentation. Let's see.
6   Yeah, I don't -- I don't recognize this first one. I
7   don't recall any of it.
8   Q   On the first page of Exhibit 46 is a name in
9   the lower right-hand corner, M. J. McArthur,
10 M-C A-R-T-H-U-R.
11   Do you know who that is?
12   A   Yes.
13   Q   Who is Mr. McArthur?
14   A   He was my boss. He worked above Korosh.
15   Q   What's his first name?
16   A   Malcom.
17   Q   Was Mr. McArthur at Sundstrand the whole time
18 you were there?
19   A   No. He retired.
20   Q   Do you recall when?
21   A   The exact date, no.
22   Q   Approximately?
23   A   One year before I left.
24   Q   Did you work with Mr. McArthur on the APS3200?
25   A   Yes.

                            36

Edward C. Edelman

July 10, 2000

1   Q   What was his responsibilities for the APS3200
2 to your knowledge?
3   A   He was the manager of the entire group. So he
4 managed -- he managed other -- he was the systems and
5 controls manager. He managed all the engine programs.
6   Q   Did his management involve engineering or was
7 it more administrative?
8   A   Administrative.
9   Q   If you turn to what's marked at the top of 1079
10 in Exhibit 46. It's also got a Bates No. HSA 176226.
11   A   Okay.
12   Q   On this page in Exhibit 46, there's a series of
13 items and some kind of a presentation. The second to
14 last of which reads, "Surge control as function of IGV
15 angle."
16   A   Uh-huh.
17   Q   Does that have any meaning for you?
18   A   No.
19   Q   In the headline for this page in Exhibit 46, it
20 states, "Load compressor controls basis T40 LC."
21   Do you see that?
22   A   Yes.
23   Q   Do you know what "basis T40 LC" means?
24   A   No.
25   Q   Have you ever heard of any device at Sundstrand

37

1 called a T40 LC?
2   A   No.
3   Q   When you began working on the control for the
4 APS3200, how did you know the way it was supposed to
5 work?
6   A   There was a systems document in place. So a
7 specification was in place.
8   Q   Do you know who generated the systems
9 specification for the 3200?
10   A   No.
11   Q   Do you know whether it was something that
12 Sundstrand developed?
13   A   Yes.
14   Q   It was from Sundstrand?
15   A   Yes.
16   Q   Did you ever work from any specifications from
17 your customer Airbus?
18   A   Yes.
19   Q   Which specification was more detailed, the
20 Sundstrand specification or the Airbus?
21   MR. McCRACKEN: Objection. Vague.
22   THE WITNESS: Could you define "detailed"? In
23 what aspect?
24 BY MR. BRAFMAN:
25   Q   Why were there two specifications, one from

38

1 Airbus and one from Sundstrand?
2   A   The Airbus specification would tell us how to
3 design. They would tell us what the guidelines or
4 requirements are for the aircraft. System specification
5 would detail how the engine would be operated.
6   Q   It was at a more nuts-and-bolts level in the
7 Sundstrand specification?
8   A   Yes.
9   Q   Do you recall if there was ever a version of
10 the APS3200 where the delta P over P was a -- let me
11 rephrase the question.
12   Do you recall if there was ever a version of
13 the APS3200 where the setpoint for delta P over P was
14 always a constant number?
15   A   As far as I recall, the setpoint was a constant
16 0.2.
17   Q   Correct me if I am wrong, but I believe you
18 said it had two possible values. That there were two
19 values available. 0.2 and .17 --
20   A   .17. .17 was a dynamic. It was mainly for a
21 dynamic setpoint.
22   Q   What do you mean by dynamic setpoint?
23   A   When you hit setpoint, the valve would move
24 faster which you wouldn't actually control with that
25 setpoint. So there's only one controlling setpoint of

39

1 0.2.
2   Q   Well, how do you hit a setpoint? Isn't it --
3   A   You can undershoot your desired value, and if
4 you undershoot that value, then we told basically the
5 logic set move the valve faster.
6   Q   What do you mean by "undershoot"?
7   A   When you are controlling on a setpoint, because
8 of something reacts faster than the control can react,
9 then you can undershoot the setpoint.
10   Q   Still having a little trouble understanding.
11   I think I understand and correct me if I am
12 wrong, that generally you are comparing delta P over P
13 as measured to a desired value, and if they don't match
14 you'll move the bleed valve; is that correct?
15   A   Yeah, that's essentially correct. You don't
16 react -- the valve doesn't really react until you reach
17 the setpoint.
18   Q   You don't need to move the bleed valve to get
19 the measured value to change?
20   A   I'm not -- I don't understand the question.
21   Q   You stated that the valve doesn't react until
22 you reach the setpoint. When you say you reach the
23 setpoint, do you mean until delta P over P reaches the
24 setpoint?
25   A   Yes.

40

Edward C. Edelman   July 10, 2000

1   Q   If the valve isn't staying in the same
2 position, why would delta P over P as measured ever
3 change?
4   MR. McCRACKEN: Objection. Vague.
5   THE WITNESS: You may not exactly want control
6 to that setpoint. You can — because of dynamic
7 effects, you can overshoot the setpoint; in other words,
8 the control can't react fast enough.
9 BY MR. BRAFMAN:
10   Q   How is the control reacting? By that, do you
11 mean moving the valve?
12   A   Yes.
13   Q   Can you explain again what you mean by the
14 terms "overshoot" and "undershoot" with respect to
15 moving the valve?
16   A   Yeah. In controls, you — because of the speed
17 of the control loop or an outside force reacting faster
18 than you can control, you can undershoot; in other
19 words, you go past your set below it temporarily, and
20 that's what I mean by dynamically until the system has a
21 chance to recover, the bleed control valve has a chance
22 to recover to the setpoint of 0.2.
23   Q   I think I understand. And I'll give you an
24 example and tell me if I've got it wrong still.
25   Let's take as an example where you measure

                          41

1 delta P over P, and it's .25. And the setpoint is 0.2.
2 Is that a realistic example?
3   A   Yeah, but — yes. Uh-huh.
4   Q   Okay. In that case, we want the .25 to get
5 lower, to get closer to the 0.2 setpoint; am I right?
6   A   Not necessarily — I mean, when you say you
7 want it to...
8   Q   Well, I am trying to understand undershoot, and
9 in my head what I was thinking as you are describing was
10 you have this measured value that is above setpoint, so
11 for example you have .25 which is higher than 0.2?
12   A   Yes.
13   Q   And that number gets lower and undershooting
14 would mean you reach .19 which is below 0.2?
15   A   Correct.
16   Q   Okay. Can you explain to me what it would be
17 that would cause the delta P over P measurement to get
18 lower?
19   A   Yes. They would quickly shut off a — an
20 aircraft valve and cause a deadheaded condition, and
21 there's no place for the flow to go.
22   Q   What do you mean by "shut off an aircraft
23 valve"?
24   A   The main engine valve on the aircraft may
25 close.

                          42

1   Q   By that, do you mean that the aircraft suddenly
2 needs less air, is requesting less air from the APU?
3   A   Yes.
4   Q   Okay. And that causes what you call the
5 deadhead condition?
6   A   Yes.
7   Q   What does "deadhead" mean?
8   A   There is no place for the flow from the load
9 compressor to exit.
10   Q   Okay. And in that example, how does the
11 control react?
12   A   It receives — it measures the delta P over P
13 and then rapidly sees a much lower value.
14   Q   Okay.
15   A   Decreasing value.
16   Q   So if I understand correctly, because the air
17 now has nowhere to go because the aircraft has lowered
18 its demand for air —
19   A   Yes.
20   Q   — the delta P over P is getting lower?
21   A   Yes.
22   Q   Okay. This may cause the valve to move so that
23 more air goes to exhaust?
24   A   Yes.
25   Q   Is it your understanding that if the setpoint

                          43

1 for delta P over P was always the same number and didn't
2 have any other options, that would be more likely to
3 lead toward surge?
4   MR. McCRACKEN: Objection. Speculative.
5   THE WITNESS: I don't understand the question.
6 BY MR. BRAFMAN:
7   Q   Why did the APS3200 control provide the second
8 value for setpoint of .17, why not always have just 0.2?
9   A   It was for dynamic undershoot, as I described.
10   So like I mentioned, if you — if you approach
11 the .17 setpoint, then the gains in the PI control would
12 increase and cause the valve to move temporarily faster
13 until you reached — you went back to the 0.2 setpoint.
14 So it was temporary. You can think of it as a temporary
15 reaction.
16   Q   Is that because it's sort of an emergency, that
17 you need things to happen quickly?
18   A   I wouldn't term it an emergency but, yes, you
19 wanted the control to react faster.
20   Q   Is the reason you want the control to react
21 faster because it's nearing surge?
22   A   Yes.
23   Q   And am I correct, then, that if you don't lower
24 the setpoint to .17, then it's more likely the APU will
25 surge?

                          44

Edward C. Edelman

July 10, 2000

1   A   You don't -- it's not that it's being lowered
2 to .17, both setpoints are active at the same time.
3   One is a steady state so it tries to control on
4 0.2. The other if it hits that setpoint causes the
5 valve to react faster.
6   Q   If there weren't the second setpoint of .17, am
7 I correct that then the APU would be more likely to
8 surge?
9   A   Yes.
10   Q   When you say that there's these two setpoints
11 being used at the same time, do you mean in software
12 language that there are two comparisons going on all the
13 time against the first setpoint and against the second
14 setpoint?
15   A   I don't recall the exact details of the
16 software implementation.
17   Q   Is that the idea though? Do I understand or am
18 I off base?
19   MR. McCRACKEN: Objection. Ambiguous.
20   THE WITNESS: I don't recall. I -- I would
21 have to look at a design document.
22   MR. BRAFMAN: Okay. Why don't we take a short
23 break.
24   VIDEOGRAPHER: Going off the record. The time
25 is 10:12 A.M.

45

1   (Recess.)
2   VIDEOGRAPHER: We're back on the record. The
3 time is 10:29 A.M.
4   MR. BRAFMAN: Back on the record.
5   I'm going to mark as Edelman Exhibit 59 a
6 document bearing production Nos. HSA 225909 through
7 225914, although that last page is actually an oversize
8 page which is missing, which I apologize.
9   (Deposition Exhibit No. 59 was marked
10   for identification by the reporter.)
11 BY MR. BRAFMAN:
12   Q   Mr. Edelman, do you recognize Exhibit 59?
13   A   Yes.
14   Q   Is this a document that you wrote on
15 approximately September 1, 1992?
16   A   Yes.
17   Q   What's the general subject matter of
18 Exhibit 59?
19   A   I'm going to go ahead and read it first.
20   Q   Sure. Please take your time.
21   MR. McCRACKEN: And you say, David, that the
22 last page has been omitted but there's a substitute
23 page?
24   MR. BRAFMAN: There's a place holder where the
25 page is supposed to be.

46

1   MR. McCRACKEN: Okay. And is that document
2 available to allow the witness to see that document?
3   MR. BRAFMAN: Unfortunately, it's not. Which
4 is -- otherwise we would have it here. But I'm not
5 going to be asking any questions about it.
6   MR. McCRACKEN: Oh, I see this was produced to
7 you in this fashion.
8   MR. BRAFMAN: That's how I received the copy,
9 unfortunately.
10   THE WITNESS: I see. Okay. So it's a
11 simulation of the bleed control valve logic, the results
12 of the simulation.
13 BY MR. BRAFMAN:
14   Q   When you say that it Exhibit 59 describes a
15 simulation, does that mean it's not describing the way
16 an actual APS3200 might have worked?
17   MR. McCRACKEN: Objection. Speculative.
18   MR. BRAFMAN: Let me rephrase the question.
19   THE WITNESS: Okay.
20 BY MR. BRAFMAN:
21   Q   Is the control logic described in Exhibit 59
22 the same logic in an APS3200 as of September '92 or was
23 it a simulation that might have differed from an actual
24 APS3200?
25   A   I don't recall.

47

1   Q   There's a reference in the subject of
2 Exhibit 59 to APS3200 software version TD2.14.
3   What does that mean?
4   A   It -- it was a software version.
5   Q   Does the TD2.14 mean anything or is it just a
6 version number?
7   A   It's just a version number.
8   Q   Does the TD reference anything?
9   A   I don't remember what we used TD for.
10   Q   Okay. Looking halfway down Exhibit 59 on the
11 front page to where it says, "Definition: Surge Control
12 Logic."
13   A   Yes.
14   Q   The first sentence there reads:
15   "The surge control consists of the
16   standard PID control (reference attached
17   logic block diagram) and a high-gain
18   control at a reduced DELPQP setpoint
19   (0.20)."
20   Is this reference to a high-gain control what
21 you were talking about earlier about their being two
22 different setpoint values?
23   A   Yes.
24   Q   The high-gain control at the reduced delta P
25 over P is referring to that condition where you were

48

Edward C. Edelman   July 10, 2000

1 near surge that you described earlier?
2   A   Yes.
3   Q   Okay. And DELPQP, that's the delta P over P?
4   A   Yes.
5   Q   And the fourth sentence under there that begins
6 "The control setpoint," it says:
7   "The control setpoints (SRGSPL) is
8   at a reduced value of 0.20, and is
9   active for DELPQP 0.2 only."
10   Do you see that?
11   A   Yes.
12   Q   Does that refresh your recollection that the
13 lower of the two setpoint values was .2 and not .17 just
14 to clarify something we said earlier?
15   A   This was a simulation, and it may have been --
16 really.:
17   Q   The numbers might have changed?
18   A   They might have changed, yeah.
19   Q   Okay.
20   A   In fact, I'm pretty sure they did change.
21   MR. BRAFMAN: I'm going to mark as Edelman
22 Exhibit 60 a document bearing production Nos. HSA 211515
23 through 211516.
24   (Deposition Exhibit No. 60 was marked
25   for identification by the reporter.)

                          49

1 BY MR. BRAFMAN:
2   Q   Can you identify Edelman Exhibit 60?
3   A   Let me read through it first.
4   Okay.
5   Q   What is Edelman Exhibit 60?
6   A   It's a coordination memo from Turbomeca to
7 Sundstrand.
8   Q   Coordination memos are memos that Turbomeca and
9 Sundstrand would send to each other in working on the
10 development of the APS3200?
11   A   Yes.
12   Q   Do you recall ever seeing Edelman Exhibit 60
13 before?
14   A   I don't recall. I mean, it looks vaguely --
15 there's some things in there that I vaguely recognize
16 but...
17   Q   And you're referring specifically to the table
18 on the second page?
19   A   Yes.
20   Q   Okay. Well, looking at the first page of
21 Exhibit 60, by the No. 2 in the middle of delta P over P
22 setpoint the first sentence states:
23   "A constant set point of 0.25 for
24   delta P over P for the opening of the
25   surge value" - probably should be

                          50

1   "valve" - "leads to a very high surge
2   margin and an unacceptable loss of
3   performances."
4   A   Yes.
5   Q   Can you explain what that means?
6   A   To the -- in the case where you are -- where
7 you are required that you regulate the valve to control
8 surge, the higher the value the worse performance. But
9 it provides additional surge margin.
10   Q   Let's take that in pieces. By "surge margin,"
11 what are you referring to?
12   A   It -- it provides you some factor of safety.
13   Q   Is it the distance that you stay away from
14 where the engine will serve as sort of like a border or
15 a cushion?
16   A   Yes. It's kind of like a safety factor.
17   Q   And why does a high surge margin lead -- lead
18 to an unacceptable loss of performance?
19   A   Because more of the flow is diverted rather
20 than it being used by the aircraft.
21   Q   So to get a high surge margin you have to dump
22 more air to the exhaust which means that's air that
23 doesn't get to the aircraft?
24   A   Yes.
25   Q   Okay. Is it the goal of -- or one of the main

                          51

1 goals of controlling the bleed valve is to provide as
2 much air as possible to the aircraft while still
3 avoiding surge?
4   A   Yes.
5   Q   And it's not good enough to leave a high surge
6 margin because then you -- you don't have good enough
7 performance, so you have to get close to surge without
8 hitting it?
9   A   Yes.
10   Q   Do you understand this reference to the
11 constant setpoint of .25 for delta P over P?
12   A   Yes.
13   Q   What does that mean?
14   A   It means that at one point in the development
15 program, the delta P over P setpoint was a constant.
16   Q   It was one value that never changed; is that
17 what that means to be a constant?
18   A   Yeah.
19   Q   And having the setpoint for delta P over P
20 being a constant that never changed is what led to the
21 unacceptable performance according to this memo?
22   A   Yes.
23   Q   I'm going to hand you what's previously been
24 marked as Exhibit 54, Greubel Exhibit 54, bearing
25 production Nos. HSA 226996 through 226308.

                          52

Edward C. Edelman

July 10, 2000

1   While you are looking it over, I'll just give
2 you the preview of what my first question will be. Is
3 this a memo that you wrote on November 13, 1992?
4   A   Yes.
5   Q   The first sentence refers to surge testing
6 performed on Q25 in November 1992.
7   Is Q25 the number of an APU?
8   A   I don't recall.
9   Q   Do you recall if at this time on this test the
10 surge controls used a constant value for the delta P
11 over P setpoint?
12   A   I'm -- I don't understand. Could you rephrase
13 that?
14   Q   Sure.
15   At -- for this -- for this test -- well, let me
16 take a step back.
17   Did you perform the test that's summarized in
18 your memo Exhibit 54?
19   A   Yes.
20   Q   Okay. And the APU control that you tested,
21 that's reflected in Exhibit 54?
22   A   Uh-huh.
23   Q   Did the control use a constant value for delta
24 P over P?
25   A   Yes, it did.

53

1   Q   In the third paragraph from the label two,
2 where the Exhibit 54 states:
3   "Increasing the setpoint to delta P
4   over P equal .25 did prevent surge
5   although there was a significant
6   undershoot,"
7   Is that a -- is the significant undershoot a
8 bad result?
9   A   Yes.
10   Q   Why is that bad?
11   A   Because the lower the delta P over P value, the
12 closer you are to surge.
13   Q   Is there a number that equals surge?
14   MR. McCRACKEN: Objection. Vague.
15   THE WITNESS: Is there a number that equals
16 surge? No.
17 BY MR. BRAFMAN:
18   Q   In other words, where you say you under- --
19 there was an undershoot to delta P over P equaling .15,
20 can you tell from that whether that means you were in
21 surge or were you a certain number away from surge?
22   A   No.
23   Q   The -- the number for surge can vary? The
24 delta P over P value that equals surge can vary?
25   A   Yes.

54

1   Q   Do you recall what the net effect of these test
2 results were?
3   MR. McCRACKEN: Objection. Vague.
4   THE WITNESS: The net result of the tests?
5 BY MR. BRAFMAN:
6   Q   Did you modify the surge control algorithm as a
7 result of this test, can you recall?
8   A   I don't recall if it was specifically this
9 test.
10   Q   Is it your recollection that you moved from
11 having a constant delta P over P setpoints to the two
12 values of setpoint that you mentioned earlier, the high
13 gain and low gain?
14   A   Yes.
15   Q   If you look on the second page of Greubel
16 Exhibit 54, under the "Recommended go forward plan,
17 0.2," you refer to the implications of raising setpoint
18 from 0.2 to .25.
19   Do you see that?
20   A   Yes.
21   Q   Do you recall what was wrong with having the
22 setpoint at the original value of 0.2?
23   MR. McCRACKEN: Objection. It assumes a fact
24 not in evidence.
25   THE WITNESS: Could you repeat the question?

55

1 BY MR. BRAFMAN:
2   Q   Sure.
3   On the first page there's a reference to
4 increasing setpoint of delta P over P to .25.
5   A   Yes.
6   Q   And the -- would you agree that the second page
7 explains that the setpoint apparently used to be 0.2 and
8 you were now testing .25; is that correct?
9   A   Yes.
10   Q   Okay. Why was -- why were you testing a
11 setpoint of .25? Was there a problem with having a
12 setpoint at 0.2?
13   A   Yes. It was to see if we could increase surge
14 margin.
15   Q   Was a setpoint of 0.2 not giving you enough of
16 a surge margin?
17   A   Yes.
18   Q   I'm going to hand you what has been previously
19 marked as Suttie Exhibit 47 bearing production
20 No. HSB 215483.
21   Is Exhibit 47 a memo from Sundstrand to
22 Turbomeca?
23   A   From Sundstrand to Turbomeca? I can't --
24   Q   Well, let me ask you, who is G. Hardy on the
25 "from" line?

56

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Edward C. Edelman   July 10, 2000

1   A   He is from Turbomeca.
2   Q   Okay. Who is S. Gates on the "to" line?
3   A   He's from Sundstrand.
4   Q   And A. Ducrow, do you know who that is?
5   A   I don't even remember.
6   Q   You are listed at the bottom as a CC on Exhibit
7 47; is that correct?
8   A   Yes.
9   Q   Do you recall receiving Exhibit 47?
10   A   No.
11   Q   Looking at Exhibit 47, do you see it says:
12   "As mentioned in some previous
13   document, it appears necessary to use a
14   delta P over P setpoint function of
15   inlet guide vane setting angle."
16   You see that?
17   A   Yes.
18   Q   Do you recall this issue coming up?
19   A   No.
20   Q   Do you have any understanding of Turbomeca's
21 statement in this memo that it appeared necessary to use
22 a setpoint as a function of the inlet guide vane
23 setting?
24   A   Could you rephrase that?
25   Q   Is it your understanding from Exhibit 47 that

                            57

1   Exhibit 47?
2   A   I was part of the APS3200 development team.
3   Q   But you can't recall anything about it?
4   A   No.
5   MR. BRAFMAN: Going to mark as Edelman
6 Exhibit 61 a document bearing production Nos. HSB 30251
7 through -252.
8   (Deposition Exhibit No. 61 was marked
9   for identification by the reporter.)
10 BY MR. BRAFMAN:
11   Q   Can you identified Edelman Exhibit 61?
12   A   Yes.
13   Q   What is it?
14   A   It's a coordination memo from me to Turbomeca.
15   Q   And you drafted — you wrote Edelman Exhibit 61
16 in January of 1993?
17   A   Yes.
18   Q   Am I correct that you wrote Edelman Exhibit 61
19 in response to the memo concerning changing the setpoint
20 as a function of inlet guide vane angle which is
21 Exhibit 47?
22   A   Yeah. Yes.
23   Q   Does reading through Edelman Exhibit 61 refresh
24 your recollection at all about the issue of having the
25 delta P over P setpoint change as a function of the

                            59

1 Turbomeca was stating that the delta P over P setpoint
2 in the APS3200 should change as a function of the inlet
3 guide vane angle?
4   A   Yeah, that's what Turbomeca is stating.
5   Q   Do you know why it appeared necessary to
6 Turbomeca to have the setpoint vary with the inlet guide
7 vane angle?
8   A   No.
9   Q   Do you recall having any discussions about this
10 topic with anybody?
11   A   Not that I can recall.
12   Q   Did you ever implement this algorithm setting
13 the setpoint as a function of the inlet guide vane angle
14 in the APS3200?
15   A   Not that I recall.
16   Q   Do you recall why you didn't follow what
17 Turbomeca suggested was necessary in this exhibit?
18   MR. McCRACKEN: Objection. Assumes a fact not
19 in evidence.
20   THE WITNESS: No.
21 BY MR. BRAFMAN:
22   Q   Do you recall what response there was to this
23 memo, if any?
24   A   No.
25   Q   Do you know why you received a copy of Suttie

                            58

1 inlet guide vane angle?
2   A   Yeah, let me go ahead and read it first.
3   Okay. So, yeah, it does — it does — I do
4 recall it.
5   Q   Do you recall it apart from reading the
6 document or just interpreting what you see in the
7 exhibit?
8   A   Interpreting what I see, yeah.
9   Q   So you don't have an independent recollection?
10   A   No.
11   Q   Okay.
12   A   Not until this moment.
13   Q   Can you summarize what you were explaining in
14 Edelman Exhibit 61?
15   A   It looks like they specified a delta P over P
16 setpoint as where alpha is IGV position.
17   And I performed a test and found out that it
18 wouldn't work, that there wasn't sufficient surge
19 margin, and so we would go back and do a study to take
20 all the factors including engine to engine variation and
21 deterioration effects to — to find out if this approach
22 is okay.
23   And then what — what I basically said here was
24 that we should leave it as the currently defined 0.2
25 value. Until we perform this study.

                            60

Edward C. Edelman

July 10, 2000

1   Q   Do you recall why Turbomeca proposed setting
2   the setpoint the way it did including the guide vane
3   angle as an input?
4   A   No.
5   Q   Did anyone ever explain to you why they
6   proposed that method?
7   A   Not that I can recall.
8   Q   Did you ever perform the study that you
9   proposed doing in Edelman Exhibit 61?
10   A   Not that I can recall.
11   Q   Do you recall what did happen next in the
12   development of the control algorithm involving the
13   setpoint angle — the setpoint setting rather?
14   A   No.
15   Q   I'm going to hand you what has been previously
16   marked as Suttie Exhibit 48 bearing production
17   Nos. HSB 215481 to -482.
18   This is another coordination memo between
19   Sundstrand and Turbomeca, correct?
20   A   Yes.
21   Q   And Exhibit 48 appears to be P. Biscay,
22   B-I-S-C-A-Y?
23   A   Yes.
24   Q   Who is that?
25   A   I don't recall.

61

1   A   No.
2   Q   I'm going to hand you what has been previously
3   marked as Suttie Exhibit 43, bearing production
4   Nos. HSA 152238 through -244.
5   Can you identify Suttie Exhibit 43?
6   A   Yes.
7   Q   This is another coordination memo between
8   Turbomeca and Sundstrand?
9   A   Yes.
10   Q   And on the second page of the document, which
11   is the front page of the memo, there's a handwritten
12   note on the left that begins "Ed."
13   Do you see that?
14   A   Yes.
15   Q   Do you understand that is a reference to you?
16   A   Yes.
17   Q   So you received a copy of Exhibit 43?
18   A   Yes.
19   Q   Do you recall receiving a copy of it or ever
20   having seen it before?
21   A   Vaguely.
22   Q   What's your best recollection about Exhibit 43?
23   A   It's a note about a parameter call to B-factor.
24   Q   What is — is the B-factor?
25   A   I would have to look at an equation to tell you

63

1   Q   Do you know if he worked for Turbomeca?
2   A   No, I don't.
3   Q   Okay. Do you recall ever seeing Exhibit 48
4   before?
5   A   No, I don't recall.
6   Q   Do you recall ever seeing or hearing about the
7   substance of Suttie Exhibit 48 which appears to be
8   further discussion about setting the setpoint of delta
9   P over P based upon the inlet guide vane angle?
10   A   I don't recall the specifics.
11   Q   Do you recall anything about it?
12   A   No.
13   Q   Do you know whether the control settings in
14   Suttie Exhibit 48 were ever implemented by Sundstrand?
15   A   I don't recall.
16   Q   Given that you were — let me ask it
17   differently.
18   Do you know why you weren't involved in this
19   discussion given that your role was so significant in
20   the control for the 3200?
21   A   No.
22   Q   Do you ever recall any of the Sundstrand people
23   listed on this memo, Exhibit 48, ever consulting you
24   about this two-tiered delta P over P setpoint based on
25   inlet guide vane angle?

62

1   exactly what it is.
2   Q   Do you recall who first came up with the idea
3   for a B-factor?
4   A   No.
5   Q   Do you recall whether it was someone from
6   Sundstrand or someone from Turbomeca who came up with
7   the idea for using a B-factor?
8   A   No.
9   Q   Do you know whether it was you?
10   A   No, I didn't come up with it.
11   Q   What was the purpose of the B-factor?
12   A   It had something to do with a dual solution but
13   I don't recall exactly.
14   Q   A dual solution to what?
15   A   I can — I would only be speculating so I
16   really don't — really can't answer that. I would have
17   to look at the exact equation.
18   Q   If you look at the little table on the first
19   page of the memo, Exhibit 43, underneath it states that
20   where alpha on the first line of the table is the inlet
21   guide vane setting angle, and that second line appears
22   to be the B-factors; is that correct?
23   A   Yes.
24   Q   Is it your recollection that the B-factors were
25   based upon the inlet guide vane angle, the inlet guide

64

Edward C. Edelman   July 10, 2000

1 vane position?
2   A   That's what this table would imply.
3   Q   Do you have an independent recollection of
4 whether that's true?
5   A   No.
6   Q   In the handwritten note on the left-hand side
7 it says, "Ed, Mike, Terry" and "Korosh"?
8   A   Uh-huh. Yes.
9   Q   "Please review and comment then incorporate,"
10 is it?
11   A   Yes.
12   Q   And that was a note written to you and the
13 others by Mr. Suttie?
14   A   Yes.
15   Q   Who is Mike and Terry?
16   A   Well, Terry was Terry Meche. I don't recall
17 who Mike was.
18   Q   And I see there is a Steve there as well. Who
19 is the Steve?
20   A   Steve Lampe.
21   Q   Do you recall ever discussing this document
22 with any of those people?
23   A   No.
24   Q   Do you recall ever commenting or incorporating
25 something from Exhibit 43?

                        65

1   MR. McCRACKEN: Objection. Vague.
2   THE WITNESS: I don't recall.
3 BY MR. BRAFMAN:
4   Q   Is it your recollection that the intent of the
5 B-factor was to include the inlet guide vane position as
6 a factor in controlling the bleed control valve?
7   MR. McCRACKEN: Objection. Vague.
8   THE WITNESS: As a factor? Could you rephrase
9 that?
10 BY MR. BRAFMAN:
11   Q   Is it your recollection that the B-factor was
12 meant to allow you to control the bleed control valve in
13 part as a function of the position of the inlet guide
14 vanes?
15   MR. McCRACKEN: Objection. Vague.
16   THE WITNESS: The purpose of the B-factor was
17 to determine what side of -- there was a curve of delta
18 P over P versus flow, I believe, I can't recall, but the
19 purpose of the B-factor was to define what side of that
20 curve you were on because it was not a function. It had
21 dual solutions. So that was the purpose of the
22 B factor.
23 BY MR. BRAFMAN:
24   Q   What was not a function but had dual solutions?
25 You said, "It was not a function. It had dual

                        66

1 solutions." What is the "it"?
2   A   The delta P over P versus airflow.
3   Q   And what was one side of the curve versus the
4 other? What was the difference between the two sides?
5   A   They had different slopes. One was positive
6 and the other was negative.
7   Q   And in controlling the bleed control valve you
8 needed to know which of the two sides of this curve you
9 were on?
10   A   Yes.
11   Q   And the B-factor, which was based on the inlet
12 guide vane angle, would allow you to figure out what
13 side of the curve you were on so you could control the
14 valve correctly?
15   A   I don't recall if it was a function of the IGV,
16 but I know that's what the B-factor was used for.
17   Q   Was the B-factor incorporated into the control
18 for the APS3200?
19   A   Yeah. When I was there, it was.
20   Q   Do you recall when it was incorporated, when
21 the B-factor was incorporated into the APS3200?
22   A   Not the exact date.
23   Q   Approximately?
24   A   No.
25   Q   Do you recall whether the B-factor was still

                        67

1 being used in the APS3200 when you left Sundstrand?
2   A   No.
3   Q   You are not sure?
4   A   I'm not sure.
5   Q   Do you recall any control algorithm for the
6 bleed control valve subsequent to March of 1993 that did
7 not involve the B-factor?
8   A   Okay. Could you rephrase that?
9   Q   Sure.
10   This memo about the B-factor, Exhibit 43, is
11 dated March --
12   Is it March or February?
13   A   It's March 2.
14   Q   March 2, 1993, correct?
15   A   Yes.
16   Q   Do you recall -- let me step back.
17   And your recollection is, in fact, the B-factor
18 was incorporated into the APS3200 at some point?
19   A   Yes.
20   Q   Okay. Do you recall subsequent to this
21 March 1993 time frame whether there was a different
22 control algorithm implemented for the bleed control
23 valve that did not use the B-factor?
24   A   I don't recall.
25   Q   Do you recall whether you had an opinion about

                        68

Edward C. Edelman   July 10, 2000

1   whether the B-factor worked in the control of the bleed
2   control valve?
3   A   Not that I can recall.
4   MR. BRAFMAN: I'm going to mark as Edelman
5   Exhibit 62 a document bearing production Nos. HSB 35443
6   through 35452. And I apologize, I just have the one
7   copy.
8   Deposition Exhibit No. 62 was marked for
9   identification by the reporter.)
10   MR. McCRACKEN: Okay.
11 BY MR. BRAFMAN:
12   Q   Can you identify Edelman Exhibit 62?
13   A   Yes. It's a memo that I wrote to Turbomeca.
14   Q   And you wrote Exhibit 62 on approximately
15 May 27, 1993?
16   A   Yes.
17   Q   Do you recall Edelman Exhibit 62?
18   A   Yes.
19   Q   In the first line of your memo, Exhibit 62, you
20 wrote:
21   "The attached memo details why the
22   B-factor as it has presently been
23   defined is not acceptable for surge
24   control."
25   Do you remember writing that?

69

1   A   When it's placed in front of me, then I do
2   recall it but...
3   Q   Do you recall why you believed at the time that
4   the B-factor was not acceptable for surge control?
5   A   Yeah. It says it in the third line. The
6   problem with the B-factor is that it does not allow free
7   inaccuracies in the sensors, and then the sensor
8   accuracy values are given in appendix B.
9   Q   Do you recall whether at the time you wrote
10 this memo in May of '93 the B-factor was being used in
11 the APS3200?
12   A   No. I don't know if it was used.
13   Q   Do you know when the first APS3200 was
14 delivered to a customer?
15   A   No.
16   Q   Do you know what algorithms were used in the
17 first commercially sold APS3200 for controlling the
18 bleed valve?
19   A   No.
20   Q   Were you ever told what version of the software
21 was going to be used in the commercial APS3200?
22   A   No.
23   Q   Did you ever come out with versions of the
24 software for the APS3200 control that were not
25 commercially used?

70

1   A   Yes.
2   Q   And do you have any way of knowing whether a
3   certain version was commercial versus non-commercial?
4   A   No.
5   Q   You don't recall there being a big party at
6   some point that a certain version was done and something
7   was going out the door?
8   A   Yeah, there wasn't a party. We were just — I
9   don't remember the exact date. I do remember when we —
10 it first went into production but I can't tie in a given
11 software version to that.
12   Q   When was the first production to your
13 recollection?
14   A   I don't recall.
15   Q   You just remember it happened; you don't
16 remember when it was?
17   A   I don't remember the year or the date.
18   Q   Okay. If you turn to, in Exhibit 62, the page
19 marked with the No. 35446.
20   A   Okay.
21   Q   At the top is a curve or a graph. Is that the
22 curve of delta P over P versus flow that you were
23 referring to earlier?
24   A   Yes.
25   Q   Can you explain a little bit about what it's

71

1   showing?
2   A   Yes. It's — it's just simply a curve of delta
3   P over P versus corrected discharge flow from the load
4   compressor.
5   Q   What is —
6   A   And also a calculated B-factor.
7   Q   And let's take it slowly.
8   What is this flow from the compressor? What is
9   that referring to?
10   A   It is output flow of the load compressor.
11   Q   So it's the flow of the air coming from the
12 compressor that's either going to be exhausted or go to
13 the aircraft?
14   A   Yes.
15   Q   You had a sensor there to measure the flow?
16   A   No. We did not have a flow sensor.
17   Q   You calculated it from other readings?
18   A   Yes.
19   Q   Why — let me rephrase that.
20   What's the significance of saying the flow was
21 corrected, the corrected flow?
22   A   It's so that you can take a number of different
23 ambient conditions and collapse the curve — the values
24 on to one curve.
25   Q   By "ambient" — what do you mean by "ambient

72

Edward C. Edelman   July 10, 2000

1   conditions"?
2   A   Pressure and temperature. Ambient means
3   outside pressure and temperature.
4   Q   So you could -- you could take this flow
5   number, and it didn't matter what altitude the aircraft
6   was at, is that --
7   A   I don't recall if that was the case.
8   Q   But in any event, it was fixing for conditions
9   of pressure and temperature outside the aircrafts?
10   A   Yes. It was compensating for that.
11   Q   Okay. And why was it you were interested in
12 knowing delta P over P versus this flow from the load
13 compressor? What's the purpose of knowing this graph?
14   A   You need to control it at a setpoint of 0.2 and
15 so you need to know what side of curve -- this curve you
16 are on. Because at high flows you can also have a low
17 delta P over P. And you only want to control to this
18 point here, shown right there, where the intersection of
19 the control setpoint and the B curve.
20   Q   So the intersection near the C of control
21 setpoint in the graph?
22   A   Yes. Right here, yeah.
23   Q   Okay. You know what, why don't we -- you want
24 to take a pen and just put an arrow or circle what you
25 are referring to?

                          73

1   A   Okay.
2   MR. BRAFMAN: And let the record reflect that
3   the witness put a circle around the intersection.
4   Q   Do I understand that you want the APU to be
5   operating near that point that you circled, or if I am
6   wrong, explain please?
7   A   No. I mean, you don't want it to operate
8   there.
9   Q   Is there an ideal place to be operating on this
10 curve?
11   A   No.
12   Q   Where was it you said you don't want to be
13 operating?
14   A   I didn't say that. I said that this curve had
15 a dual solution, and so you would not necessarily want
16 to control the bleed control valve in a high flow
17 condition.
18   Q   Why not?
19   A   Because it would result in positive feedback
20 and the valve would open all the way instead of
21 regulating to control surge.
22   Q   Can you explain that a little bit more?
23   High flow means that there's a lot of air
24 coming out of the compressor, right?
25   A   Yeah. It means that -- yes, there's -- there's

                          74

1   no restriction downstream. So downstream is the air --
2   are aircraft valves. So the aircraft valves are open
3   and there's a large amount of flow.
4   Q   So the aircraft wants a lot of air under this
5   condition?
6   A   Yes. Uh-huh.
7   Q   And you don't want to control the valve because
8   you want all the air to go to aircraft; is that correct?
9   A   Yes.
10   Q   Okay. And reading delta P over P won't let you
11 know whether or not you are in a situation where the
12 aircraft wants all the air; is that what you are
13 explaining?
14   A   Yes. There is -- this curve has a dual
15 solution.
16   Q   And by "dual solution," you mean for a single
17 value that you have measured of delta P over P, you
18 can't tell whether the aircraft wants a lot of air or
19 doesn't want a lot of air.
20   Is that a fair way to summarize it?
21   A   Yes.
22   Q   There's a vertical line that ends by an arrow
23 at the top of the graph, B(C).
24   You see that?
25   A   Yes.

                          75

1   Q   Am I understanding correctly that to the left
2   of that vertical line is where you want the valve, the
3   bleed control valve, to move variably?
4   A   Yes.
5   MR. McCRACKEN: Objection. Vague.
6   BY MR. BRAFMAN:
7   Q   But to the right of the line you want the valve
8   to let all the air to go to the aircraft?
9   A   Yes.
10   Q   Okay. What does B(c), B sub C, stand for? By
11 the arrow at the top of the graph.
12   A   It defines the apex of that curve.
13   MR. BRAFMAN: Why don't we take a short break.
14   VIDEOGRAPHER: This is the end of videotape
15 No. 1 in the deposition of Ed Edelman. We're going off
16 the record. The time is 11:22 A.M.
17   (Recess.)
18   VIDEOGRAPHER: We're back on the record.
19   The time is 11:39 A.M. and this marks the
20 beginning of videotape No. 2 in the deposition of
21 Ed Edelman, the deposition which is being taken at 777
22 South Figueroa Street, 34th Floor in Los Angeles,
23 California.
24   The videographer is Lisa Livote, employed by
25 Esquire Deposition Services, located at 6222 Wilshire

                          76

Edward C. Edelman

July 10, 2000

1   Boulevard, Suite 204, in Los Angeles, California.
2   BY MR. BRAFMAN:
3   Q   You testified a little while ago that the
4   APS3200 doesn't measure directly the flow from the load
5   compressor but calculates it from other measurements; is
6   that right?
7   A   Specifically this corrected CDP flow is not
8   a -- it uses a number of parameters to calculate.
9   Q   What does the CDP stand for?
10   A   Compressor discharge pressure, I believe.
11   Q   What does the APS3200 measure that allows it to
12 calculate that flow?
13   A   I -- I can't recall.
14   Q   Do you have any recollection at all about what
15 parameters are involved?
16   A   I would have to look at a diagram or an
17 equation.
18   Q   When the B-factor was implemented into the
19 control of the bleed control valve was the APS3200 still
20 using the two setpoints: High gain, low gain values?
21   A   I'm not sure I understand.
22   Q   We talked about -- earlier this morning about a
23 certain version of the APS3200 control where the
24 delta P over P setpoint had a high-gain value and a
25 low-gain value.

77

1   A   Yes.
2   Q   Okay. There's also a version of the APS3200
3   control that used the B-factor in controlling the bleed
4   control valve, correct?
5   A   Yes.
6   Q   Okay. My question is, once the B-factor
7   control was used, did the delta P over P setpoint still
8   have a high-gain value that differed from a low-gain
9   value, or was there a different calculation used for the
10 setpoint?
11   A   I don't recall.
12   Q   How was the B-factor used in the control of the
13 surge control valve?
14   A   We talked about this before. But the B-factor
15 determines which side of the curve you are on.
16   Q   So there was a -- some sort of a test about
17 what the B-factor was, and if it was on one side of the
18 curve, the control did one thing; and if it was on the
19 other side of the curve, the control did the other
20 thing?
21   A   Yes.
22   Q   If the B-factor told the controller that you
23 were on the left side of the curve, which was the lower
24 flow curve where the aircraft wasn't demanding all that
25 much air, would the control then just continue as it

78

1   would have without the B-factor involved?
2   MR. McCRACKEN: Objection. Vague.
3   THE WITNESS: Yep, that -- that question didn't
4   make too much sense.
5   BY MR. BRAFMAN:
6   Q   Well, there was a time when there was no
7   B-factor in the APS3200, correct?
8   A   Yes.
9   Q   And there was a control strategy for the bleed
10 control valve, correct?
11   A   Yes.
12   Q   Was the B-factor simply used to determine
13 whether to continue with that same control strategy you
14 had previously as opposed to letting the bleed valve
15 stay all the way open?
16   A   What the logic does is if you are on the
17 right-hand side of the curve it commands the bleed valve
18 to the open position all of -- all of the time.
19 Otherwise you are controlling...
20   Q   And that's the part I am focussing on.
21   How are you controlling on the left side of the
22 curve?
23   A   As previously described. You are looking at
24 delta P over P and a setpoint.
25   Q   Was the position of the inlet guide vanes used

79

1   in any part of this control of the bleed control valve
2   that uses the B-factor?
3   MR. McCRACKEN: Objection. Vague.
4   THE WITNESS: Not that I can recall.
5   BY MR. BRAFMAN:
6   Q   Do you recall that it didn't use the inlet
7   guide vanes or you just don't remember either way?
8   A   I don't remember either way.
9   Q   Do you recall the resolution of the problem you
10 described in Edelman Exhibit 62?
11   A   How was -- is dual solution resolved, no, I
12 don't.
13   MR. BRAFMAN: I'm going to mark as Edelman
14 Exhibit 63 a document bearing production Nos. HSB 285004
15 through -006.
16   (Deposition Exhibit No. 63 was marked
17   for identification by the reporter.)
18 BY MR. BRAFMAN:
19   Q   Can you identify Edelman Exhibit 63, please?
20   A   Yes. It's a problem and corrective action
21 report, and it was written by me.
22   Q   What's a problem and corrective action report?
23   A   If a -- it was a method for fixing problems.
24 So if a problem occurred, we would write a report and
25 then there would be some corrective action in the end to

80

Edward C. Edelman

1 fix it.
2 Q "We," meaning people at Sundstrand?
3 A Yes.
4 Q This report that you wrote, Edelman Exhibit 63,
5 was written in April 1993?
6 A Yes.
7 Q Do you remember what the problem was that led
8 to the report, Edelman Exhibit 63?
9 A Let me go ahead and read it first.
10 Yeah, I remember.
11 Q What was the problem that led to Edelman
12 Exhibit 63?
13 A The problem is that we could not -- because of
14 actuation pressure, we could not move the inlet guide
15 vanes and the bleed control valve at the same time when
16 you were first sequencing them to open positions. So we
17 would sequence them at different times.
18 Q When did you first sequence them to open
19 positions?
20 A I don't recall exactly when.
21 Q Is this problem and resolution related to the
22 way the control algorithm worked all the time or was it
23 just an initialization procedure?
24 A Yeah. It was an initialization procedure.
25 Q In the description on the first page of Edelman

81

1 A No, I don't recall.
2 Q Looking at the second page of Exhibit 45 under
3 the second heading, "Computation of Corrective Bleed
4 Airflow."
5 Do you see that?
6 A Yes.
7 Q Do you know if that's referring to the
8 corrective flow from the load compressor you discussed
9 earlier with respect to the B-factor graph?
10 A Yes.
11 Q Okay. The first bullet point under
12 "Computation of corrected bleed airflow" in Exhibit 45
13 has IGV angle in degrees written in italics and
14 bracketed.
15 Do you know why that is, why it's written that
16 way?
17 A No.
18 Q Have you seen this bulleted list before
19 relating to computation of corrected bleed air flow?
20 A Not that I can recall.
21 Q Do you understand what it's referring to?
22 A They are -- they are all the parameters that
23 are required to calculate corrected flow.
24 Q Does seeing this description here about
25 computing corrected bleed airflow refresh your

83

1 Exhibit 63, towards the end, by No. 2, it states:
2 "Delay bleed control valve to
3 control based on IGV feedback."
4 What does that mean?
5 A It means that we would delay opening the BCV
6 until the IGV reached a certain setpoint.
7 You didn't want both of these moving --
8 initializing at the same time so we would move the IGV
9 first and then we would move the BCV.
10 Q In the recommended solutions there's a line
11 "Flight test critical."
12 Does that mean that the APS3200 was in the
13 flight test phase of development at this time?
14 A I could only assume. But I don't know.
15 Q You don't remember.
16 I'm going to hand you what has been previously
17 marked as Suttie Exhibit 45 bearing production
18 Nos. HSA226567 through 226576.
19 The heading on the pages of Exhibit 45 states,
20 "Interface Control Document."
21 Do you know what that means?
22 A Not exactly.
23 Q Have you -- do you recall receiving Exhibit 45
24 around the time it was written, which is at the bottom
25 of Exhibit 45 states September 1993?

82

1 recollection about how it was done in the APS3200?
2 A Not exactly. I would have to see the entire
3 equation.
4 Q About three-quarters of the way down on the
5 second page of Exhibit 45 there's an equation that
6 begins "B equals."
7 Do you know what that equation is for?
8 A It is -- it's the B-factor.
9 Q Is that the APS3200 calculated the B-factor?
10 A I don't know. Could be that what was written
11 in this memo was different than we what we actually
12 implemented.
13 Q The last line on the second page of Exhibit 45
14 refers to the parameter B with a little C.
15 Do you know what that's referring to?
16 A Yes. B(c) is the APEX of the B-factor curve.
17 Q In this sentence, it states that, "The
18 parameter B(c) is the choking threshold"?
19 A Yeah.
20 Q What does that mean? What is a choking
21 threshold?
22 A Yeah, that -- at higher flows you would -- the
23 flow would be choked so that delta P over P would drop
24 off. So it's just -- it's really defining the apex of
25 that curve that we looked at previously.

84